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TABLE 1 (Continued)

Gland and AS568 Dash No.	Piston or Cylinder OD C	Cylinder Bore ID A	Gland OD F	Rod or Gland Sleeve OD B	Rod Bore ID H	Gland ID E	Actual Minimum Squeeze ------- Piston/ Rod	Actual Maximum Squeeze ------- Piston/ Rod
441	7.470 7.468	7.474 7.477	6.997 6.994	6.997 6.994	7.001 7.004	7.474 7.477	.0182 .0177	.0480 .0485
442	7.720 7.718	7.724 7.727	7.247 7.244	7.247 7.244	7.251 7.254	7.724 7.727	.0181 .0176	.0480 .0485
443	7.970 7.968	7.974 7.977	7.497 7.494	7.497 7.494	7.501 7.504	7.974 7.977	.0182 .0177	.0480 .0485
444	8.220 8.218	8.224 8.227	7.747 7.744	7.747 7.744	7.751 7.754	8.224 8.227	.0183 .0178	.0480 .0485
445	8.470 8.468	8.474 8.477	7.997 7.994	7.997 7.994	8.001 8.004	8.474 8.477	.0183 .0178	.0480 .0485
446	8.970 8.967	8.974 8.977	8.497 8.494	8.497 8.494	8.501 8.504	8.974 8.977	.0177 .0177	.0485 .0485
447	9.470 9.467	9.474 9.478	8.997 8.994	8.997 8.994	9.001 9.004	9.474 9.478	.0168 .0173	.0485 .0485
448	9.970 9.967	9.974 9.978	9.497 9.494	9.497 9.494	9.501 9.504	9.974 9.978	.0169 .0174	.0485 .0485
449	10.470 10.467	10.474 10.478	9.997 9.994	9.997 9.994	10.001 10.004	10.474 10.478	.0170 .0175	.0485 .0485
450	10.970 10.967	10.974 10.978	10.497 10.494	10.497 10.494	10.501 10.504	10.974 10.978	.0170 .0175	.0485 .0485
451	11.470 11.467	11.474 11.478	10.997 10.994	10.997 10.994	11.001 11.004	11.474 11.478	.0170 .0176	.0485 .0485
452	11.970 11.967	11.974 11.978	11.497 11.494	11.497 11.494	11.501 11.504	11.974 11.978	.0171 .0176	.0485 .0485
453	12.470 12.467	12.474 12.478	11.997 11.994	11.997 11.994	12.001 12.004	12.474 12.478	.0172 .0177	.0485 .0485
454	12.970 12.967	12.974 12.978	12.497 12.494	12.497 12.494	12.501 12.504	12.974 12.978	.0173 .0178	.0485 .0485
455	13.470 13.467	13.474 13.478	12.997 12.994	12.997 12.994	13.001 13.004	13.474 13.478	.0173 .0178	.0485 .0485
456	13.970 13.967	13.974 13.978	13.497 13.494	13.497 13.494	13.501 13.504	13.974 13.978	.0172 .0177	.0485 .0485
457	14.470 14.467	14.474 14.478	13.997 13.994	13.997 13.994	14.001 14.004	14.474 14.478	.0173 .0178	.0485 .0485
458	14.970 14.967	14.974 14.978	14.497 14.494	14.497 14.494	14.501 14.504	14.974 14.978	.0173 .0178	.0485 .0485
459	15.470 15.467	15.474 15.478	14.997 14.994	14.997 14.994	15.001 15.004	15.474 15.478	.0174 .0179	.0485 .0485
460	15.970 15.967	15.974 15.978	15.497 15.494	15.497 15.494	15.501 15.504	15.974 15.978	.0174 .0179	.0485 .0485

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TABLE 2 - Standard Gland Width for Zero, One, and Two Backup

Gland and AS568 Dash No.	O-ring Cross Section W Min	O-ring Cross Section W Max	Gland Width G No Backup Ring Min	Gland Width G No Backup Ring Max	Gland Width G One Backup Ring Min	Gland Width G One Backup Ring Max	Gland Width G Two Backup Rings Min	Gland Width G Two Backup Rings Max
001	.037	.043	.070	.075	--	--	--	--
002	.047	.053	.077	.082	--	--	--	--
003	.057	.063	.088	.093	--	--	--	--
004 to 009	.067	.073	.098	.103	.154	.164	.210	.220
010 to 028	.067	.073	.094	.099	.150	.160	.207	.217
110 to 149	.100	.106	.141	.151	.183	.193	.245	.255
210 to 247	.135	.143	.188	.198	.235	.245	.304	.314
325 to 349	.205	.215	.281	.291	.334	.344	.424	.434
424 to 460	.269	.281	.375	.385	.475	.485	.579	.589

TABLE 3 - Standard Gland Diametral Clearance Dimensions

Gland and AS568 Dash No.	O-ring Cross Section W Min	O-ring Cross Section W Max	Diametral Clearance D Max Exterior	Diametral Clearance D Max Interior
001	.037	.043	.004	.004
002	.047	.053	.004	.004
003	.057	.063	.004	.004
004 to 012	.067	.073	.004	.004
013 to 028	.067	.073	.005	.005
110 to 126	.100	.106	.005	.005
127 to 129	.100	.106	.005	.006
130 to 132	.100	.106	.006	.006
133 to 140	.100	.106	.006	.007
141 to 149	.100	.106	.007	.007
210 to 222	.135	.143	.005	.005
223 and 224	.135	.143	.006	.006
225 to 227	.135	.143	.006	.007
228 to 243	.135	.143	.007	.007
244 and 245	.135	.143	.008	.007
246 and 247	.135	.143	.008	.008
325 to 327	.205	.215	.006	.006
328 and 329	.205	.215	.006	.007
330 to 345	.205	.215	.007	.007
346 to 349	.205	.215	.008	.007
425 to 438	.269	.281	.009	.009
439 to 445	.269	.281	.009	.010
446	.269	.281	.010	.010
447 to 460	.269	.281	.011	.010

TABLE 4 - Standard Corner Radius Dimensions

Gland and AS568 Dash No.	Corner Radius Maximum	Corner Radius Minimum
001 to 028	.015	.005
110 to 149	.015	.005
210 to 247	.025	.010
325 to 349	.035	.020
425 to 460	.035	.020

TABLE 5 - Eccentricity for Standard Glands

Gland and AS568 Dash No.	Maximum Eccentricity
001 to 028	.002
110 to 149	.002
210 to 247	.003
325 to 349	.004
425 to 460	.005

3.1.4 Surface Finishes of Glands: The following surface finishes in Table 6 (indicated as surface roughness as defined in ANSI B46.1) shall be used in units containing O-ring seals:

TABLE 6

Part on Unit	Surface Roughness Ra (µin)
Cylinder bore or piston rod (diameter over which packaging must slide)	4 to 16[1]
O-ring groove diameter:	
Dynamic Seals	32 (max)
Static Seals	63 (max)
O-ring groove sides when no backup ring is used:	
Dynamic Seals	32 (max)
Static Seals	63 (max)
O-ring groove sides when backup rings are used	63 (max)

[1]Recommended range is 8 to 12.

The groove surfaces must be free from all machining irregularities exceeding the above values. Groove edges shall be smooth and true and free of nicks, scratches, and burrs, etc.

3.1.5 O-ring Seal Squeeze: The minimum squeeze (See Table 1) is represented by the difference (interference) between the minimum cross-section of the installed O-ring and the maximum permitted gland depth. The O-ring used to calculate minimum squeeze is one with the minimum free cross-section diameter and minimum ID. The minimum cross-section diameter of the installed O-ring is obtained by subtracting the change in the minimum free

3.1.5 (Continued):

cross-section diameter, caused by the stretching of the O-ring during installation, from the minimum free cross-section diameter. The maximum gland depth is that obtained using gland parts that provide the maximum possible diametral clearance, maximum eccentricity of gland parts and maximum possible radial displacement of the gland parts in the direction to cause maximum gland depth and minimum seal squeeze at the seal location that is 180° away from the direction of radial displacement.

The maximum O-ring squeeze in Table 1 is represented by the difference between the maximum cross-section diameter of an installed O-ring and the minimum gland depth. The O-ring used to calculate maximum squeeze is an O-ring of maximum free cross-section diameter and maximum ID. The maximum cross-section diameter of the installed O-ring is obtained by subtracting the change in the maximum free cross-section diameter, caused by the stretching of the O-ring during installation, from the maximum free cross-section diameter. The minimum gland depth for a piston type gland is that obtained using MIN bore diameter, MIN piston diameter, maximum eccentricity of gland parts and maximum possible radial displacement of the MIN piston diameter with respect to the MIN bore diameter. The minimum gland depth for a rod type gland is that obtained using MAX rod diameter, MAX rod clearance diameter, maximum eccentricity of gland parts and maximum possible radial displacement of the MAX rod diameter with respect to the MAX rod clearance diameter.

The formulas used for calculating the reduced seal cross-section for piston and rod type glands under minimum and maximum squeeze conditions are listed in Appendix A. The formulas used to calculate the minimum and maximum seal squeeze (listed in Table 1) for piston and rod type glands are also listed in Appendix A.

3.1.6 Temperature Considerations in Gland Design: The calculations used in this standard have been based on a temperature of 75 °F (24 °C). The suitability of the glands should be verified for the temperature extremes expected in service. Differences in the coefficient of expansion of different metals can result in differences in diametral clearance which may be a factor at temperature extremes. Even more important is the difference in the coefficient of thermal expansion of the seal material and the gland materials. Elastomers may have a coefficient of expansion as much as 10 times that of steel. Gland overfill at high temperatures must be avoided. Elastomer contraction at low temperatures may require some modification of the gland dimensions herein to assure adequate squeeze at low temperatures, particularly those lower than -40 °F (-40 °C). A particularly severe application occurs when an unpressurized cylinder at low temperature is pressurized. Leakage is likely to occur until such time as warmer fluid causes expansion of the elastomer. Leakage can be prevented in such cases by ensuring that adequate squeeze is provided by taking into account changes in gland and elastomer dimensions that occur at low temperature plus the radial expansion (i.e., gland "breathing") that will occur with the application of pressure. Usually, satisfactory designs can be achieved within the dimensions of this standard by simply reducing the permitted tolerances on mating parts to achieve increased squeeze.

3.1.7 Installation of Nonextrusion Rings: For pressures above 1500 psi, the use of two backup rings in each gland, one on either side of the O-ring seal, is recommended to insure proper backup ring installation, where space permits. Dimensions for gland widths to accommodate the use of two backup rings are shown in Table 2. Where it is self evident that pressure can be applied from one direction only and space requirements for two rings create a hardship, a single backup ring may be used. This ring is to be placed on the side of the O-ring away from the pressure. The groove width dimensions shown in Table 2 for one backup ring may be used, as applicable. For applications where the pressure does not exceed 1500 psi, backup rings are not required but may be used to provide greater extrusion protection.

Glands are designed to be compatible with Continuous Turn PTFE backup rings in accordance with MS27595, spiral PTFE backup rings in accordance with MS28782 and MS28783, and single-turn PTFE backup rings in accordance with MIL-R-8791/1.

3.1.8 Diametral Clearances: The diametral clearance, "D" in Figure 1, is the total difference between the bore ID (A) and the piston OD (C) or the total difference between the rod OD (B) and the rod bore ID (H). The diametral clearance shall be as listed in Table 3.

3.1.9 Groove Detail: Details for the standard groove design, including edge break and groove wall angle requirements, are depicted in Figure 2. Groove corner radius shall be in accordance with Table 4.

3.1.10 Eccentricity: The eccentricity, referred to in Table 5, is the total indicator reading, between the groove and the adjacent bearing surface (see Figure 2). As indicated in Figure 1, the designated surfaces shall be concentric within the limits of Table 5.

3.1.11 Cylinder Breathing: For operating pressures of 3000 psig and lower, radial expansion of the cylinder bore (i.e., cylinder wall "breathing") shall be limited to .002 in/in of cylinder bore at operating pressure. For operating pressures greater than 3000 psig, radial expansion of the cylinder bore shall be limited to .0015 in/in of cylinder bore at operating pressure.

3.1.12 O-ring Assembly: To facilitate O-ring assembly, the edge where the piston and O-ring assembly enters a cylinder bore should be chamfered to prevent pinching or other damage to the O-ring seal (see Figure 3).

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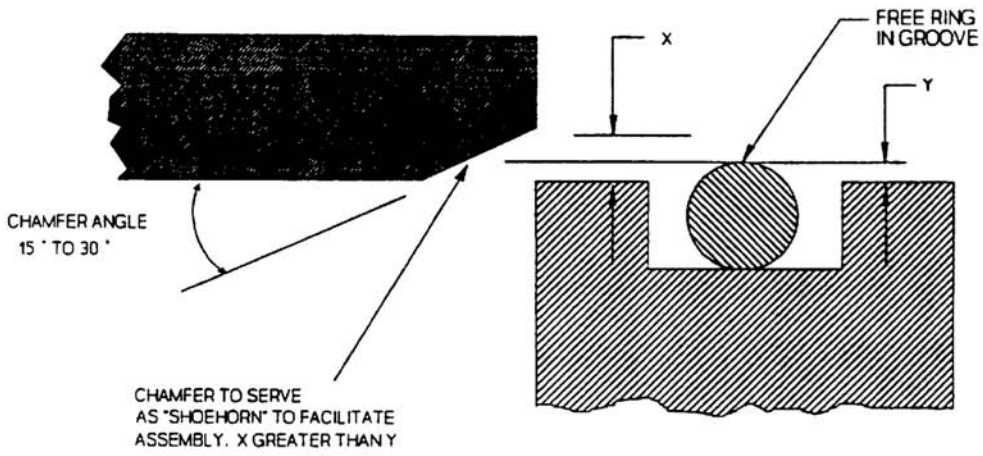

FIGURE 3 - O-ring Assembly

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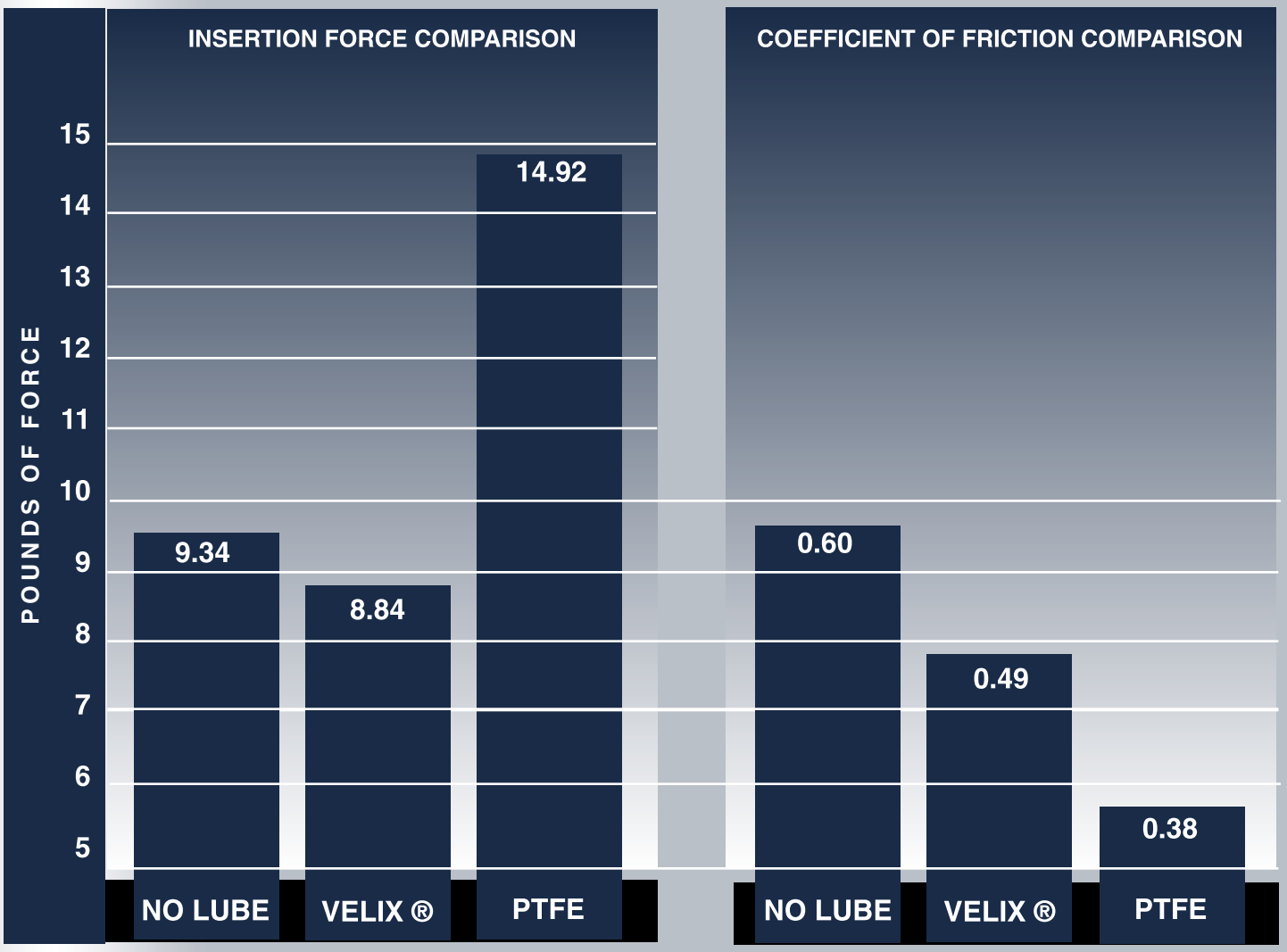

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